HEALTH CONSULTATION

Technical Assistance for a Private Well

RIVERFRONT
(a/k/a NEW HAVEN PUBLIC WATER SUPPLY SITE)
NEW HAVEN, FRANKLIN COUNTY, MISSOURI
EPA FACILITY ID: MOD981720246

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Prepared by:

Missouri Department of Health and Senior Services
Section for Environmental Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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STATEMENT OF ISSUES AND BACKGROUND

Statement of Issues
The Missouri Department of Health and Senior Services (DHSS), in cooperation with the federal Agency for Toxic Substances and Disease Registry (ATSDR), completed this health consultation at the request of the U.S. Environmental Protection Agency (EPA). The purpose of this health consultation is to provide technical assistance in determining if the provision of bottled water for a home with tetrachloroethylene (PCE)-contaminated water related to the Riverfront site is protective of health.This health consultation documents a verbal opinion provided to EPA officials at a public meeting in New Haven on November 15, 2001, and subsequent public health activities.

Background
The Riverfront site encompasses a plume of tetrachloroethylene-contaminated groundwater underlying an area near the town of New Haven, Missouri (1). EPA EXIT proposed the site for the National Priorities List (NPL) because of the presence of this contaminant plume, which has affected the town's municipal water supply (1). PCE has been detected in municipal wells at levels above EPA's Maximum Contaminant Level (MCL) for tetrachloroethylene of 5 parts per billion (ppb) PCE (1). The MCL is the highest permissible level EPA allows in public drinking water. The municipal water supply is the only source of drinking water for New Haven, and it serves the town's entire population of more than 1,700 people (1).

Private wells located outside the city limits were, and still are, in use (1). A review of private well records indicates that most private wells in the New Haven area are open to (cased to) depths similar to city wells #1 and #2 (1). This aquifer is contaminated with PCE (1). Due to insufficient data on contamination in private wells and the complex hydrogeology of the area, it is possible that people using private drinking water wells are drinking PCE-contaminated water above the MCL (1).

On November 15, 2001, representatives from the U.S. Geological Survey (USGS) conducted water sampling south of the city limits of New Haven along Boeuf Lutheran Road. This area is down-gradient of Operable Unit 2 (OU2). Figure 1 in the appendix is a map showing the operable units of the site. Figure 2 shows the location of Boeuf Lutheran Road. One of the water samples collected was from a home with a private well. USGS personnel used a portable gas chromatograph to screen the sample for contaminants. The results of this screening indicated that PCE contamination was above 200 ppb in this drinking water well. USGS returned the next day to the residence to collect another water sample to send to a laboratory to confirm the level of PCE contamination. Laboratory results indicated that the sample (collected at the kitchen sink) contained 210 ppb PCE.

DISCUSSION

The Maximum Contaminant Level (MCL) for PCE in public drinking water supplies is 5 ppb. Although this well is a private well and is not part of the public water supply, DHSS generally applies the same levels of

protection to private wells as it does public wells. EPA also has developed Drinking Water Health Advisories (HA) for public drinking water. The Lifetime HA is the concentration, which includes a margin of safety, of a chemical in drinking water that is not expected to cause any adverse non-carcinogenic effects over a lifetime of exposure (70 years). The Lifetime HA for PCE is 10 ppb. The drinking water in this private well is more than 20 times the Lifetime HA for PCE, and more than 40 times the MCL.

The well in question serves a private residence, so human exposure through other uses of this water, in addition to drinking (ingestion exposure), must be considered. PCE is a volatile organic compound that dissipates easily from water into the air, especially when water is heated. This means that residents also will be exposed to PCE through inhalation during showering and bathing, washing dishes and clothes, and cooking. Two options for providing clean water were considered, bottled water and a whole-house water filtration system. Although providing bottled water will reduce or eliminate ingestion exposures, it will not reduce inhalation exposures in the home. DHSS and ATSDR recommended to EPA that a whole-house water filtration system be put in the home as soon as possible to reduce or eliminate inhalation, ingestion and dermal exposures. Also, ATSDR representatives visited with the homeowners the following day to provide health education and to answer any questions regarding the recommendations made.

On November 27, 2001, a whole-house water filtration system was installed at the residence in question. An EPA On-scene Coordinator was present during the installation to oversee proper installation of the system.The homeowners were instructed on how to maintain the filtration system. Follow-up sampling showed that the filtered water had no detectable amount of PCE.

TOXICOLOGICAL EVALUATION

Introduction
This section will discuss the health effects of exposure to specific contaminants. To evaluate health effects, ATSDR has established Minimal Risk Levels (MRL) for contaminants commonly found at hazardous waste sites. An MRL is an estimated level of daily human exposure to a contaminant which is unlikely to result in non-cancer health effects. Exceeding an MRL does not necessarily mean that health effects definitely will occur. It indicates the need for further investigation into whether health effects might or might not be expected to occur. MRLs are developed for each environmental route (e.g., water, air) of exposure (e.g., ingestion inhalation) and for the duration of exposure. Exposure is considered to be a) acute when it occurs for 14 days or less, b) intermediate when it occurs for 15 to 364 days, or c) chronic when it occurs for 365 days or more.

Tetrachloroethylene
People can be exposed to PCE through inhalation while showering, bathing, washing and cooking. DHSS estimated inhalation exposure of residents from their use of water containing 200 ppb of PCE. These calculations were made using very conservative assumptions and can be found in the Appendix. Exposures were found to be below the MRL for acute inhalation exposures to PCE (2). ATSDR has not developed MRLs for intermediate exposure to PCE (2). Exposures were found to be higher than MRLs for chronic exposures to PCE (2). Because the chronic inhalation exposure exceeded the MRL, more investigation was needed to determine if health effects are likely to occur from exposures (2). The calculated dose of 0.81 mg/cubic meter or 0.15 parts per million (ppm) was compared to studies with known exposure doses (2). The doses expected near the Riverfront site were below the No Observed Adverse Effect Level (NOAEL) of studies involving chronic exposures to PCE in humans (2). A NOAEL is a chemical specific dose at which no adverse health effects were observed in the study subjects (2). Therefore, no adverse health effects are expected from inhalation exposures related to this site.

People can be exposed to PCE through ingestion by drinking contaminated water. Because of insufficient data, ATSDR does not have intermediate and chronic ingestion guidelines for PCE (2). Acute ingestion exposures were calculated, using 200 ppb concentration in drinking water. These calculations can be found in

the appendix. To calculate a dose, we assumed that adults, on average drink 2 liters (66 ounces) of tap water each day and weigh 70 Kilograms (Kg) (154 pounds) (2). For children, we assumed that they drink 1 liter of tap water each day and weigh 10 Kg (22 pounds) (2). Doses were compared to studies with known exposure doses. The doses for adults and children at this site did not exceed any NOAELs in studies involving chronic exposures to PCE when those studies were adjusted for human rather than animal subjects (2).

People can be exposed through dermal (skin) contact by bathing in PCE contaminated water. Since ATSDR has no methodology to determine the amount of absorption of chemicals through the skin, the agency has not established recommended levels for skin exposure (2). For this reason, it is difficult to determine health effects from skin exposure. However, on the basis of previous health studies involving accidental skin contact, it is considered unlikely that exposure to PCE at this residence would be irritating to the skin (2).

Multiple Pathways

The estimated exposure doses for inhalation and ingestion exposures, when calculated individually, are below NOAELs in studies involving chronic exposures to PCE. However, these exposures are actually occurring simultaneously and are affecting the same target organs in the body (kidney, liver, lungs, and brain)(2). When the total exposure dose (inhalation and ingestion) is compared to studies involving chronic exposures to PCE, the calculated dose is slightly above the Lowest Observed Adverse Effect Level (LOAEL) when studies are adjusted for human rather than animal subjects (2). Because each person is a unique individual, and their sensitivity and tolerance to exposures depends on many individual factors, it is difficult to determine what health effects, if any, would be expected to occur in the exposed population.

Because of the conservative nature of the assumptions made in the calculations to estimate exposure, actual exposures may be lower than the calculated exposures used for comparison to studies.

Children and Sensitive Populations

A sensitive population will exhibit a different or enhanced response to hazardous chemicals than most persons exposed to the same level of hazardous chemicals in the environment (2). Reasons for sensitivity might include genetic makeup, age, health and nutritional status, and exposure to other toxic substances (2). In general the elderly, with declining organ function, and the young, with immature and developing organs, are more vulnerable to toxic substances than healthy adults (2).

The developing fetus and children, especially the developing nervous system, may be particularly susceptible to the toxic effects of PCE (2). Studies in mice suggest that PCE can cross the placental barrier and that trichloroacetic acid (TCA) (a breakdown product of PCE) concentrates in tissues of the fetus (2). These studies have found unmetabolized PCE to be excreted in breast milk and have detected PCE in an infant with liver damage (2).

Some adults appear to have increased sensitivity to high doses of PCE (e.g., cardiac sensitization) (2). Since high doses of PCE are known to cause liver and kidney effects, persons with clinical or subclinical kidney or liver disease may be predisposed to the effects of PCE (2). People who abuse alcohol, or are treated with disulfiram (a drug used to treat chemical dependency) may be more susceptible to the toxic effects of PCE (2). Persons with pre-existing nervous system diseases also may be more sensitive to the neurotoxic effects of PCE (2).

Cancer

EPA has developed cancer unit risk factors that can be used to determine the theoretical cancer risk for adults exposed to hazardous chemicals. Cancer risks are calculated over a lifetime which is estimated at 70 years. The American Cancer Society estimates that in America, half of all men and one-third of all women will develop some form of cancer in their lifetimes (3). DHSS has calculated the cancer risk for the Riverfront site. These calculations can be found in the appendix. These calculations were made using an exposure level of 200 ppb PCE in water with exposure lasting for 20 years. Overall, there is an elevated calculated risk of developing cancer from a lifetime of exposure to contaminated groundwater at/near the Riverfront site. However, we would not expect an increase in the actual cancer rate for residents living at/near the Riverfront

site. Because most residents would not spend their entire lifetime living near the site, and may not have daily contact with contaminated water, it is unreasonable to believe that the actual cancer rate among New Haven area residents would increase.

CONCLUSIONS

1. Providing bottled water for a home with PCE contaminated water only eliminates ingestion exposures and would not be protective of health.

2. If possible, all routes of exposure (inhalation, ingestion and dermal contact) to the PCE-contaminated well water above the MCL should be reduced or eliminated.

Because a whole house filtration system has been installed at this home, we classify current exposures from private well water at this residence as posing no public health hazard.

RECOMMENDATIONS

1. A whole house filtration system is the best choice for removal of PCE from contaminated well water at the individual residence in question.

2. Private well sampling should continue south of Operable Unit 2 to determine if other families are unknowingly drinking PCE contaminated water.

PUBLIC HEALTH ACTION PLAN

This Public Health Action Plan (PHAP) for the Riverfront site contains a description of actions to be taken by the Missouri Department of Health and Senior Services (DHSS), the Agency for Toxic Substances and Disease Registry (ATSDR) and others. The purpose of the PHAP is to ensure that this public health consultation not only identifies public health hazards, but provides an action plan to mitigate and prevent adverse human health effects resulting from past, present, and/or future exposures to hazardous substances at or near the site. Included is a commitment from DHSS and/or ATSDR to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by DHSS, ATSDR, and/or cooperators are as follows:

Completed Activities

1. ATSDR representatives met with the family to answer any health questions or concerns the family had regarding PCE-contamination in their well.

2. USGS performed confirmatory sampling, and determined that field estimates of contamination were accurate.

3. Based on verbal recommendations by DHSS/ATSDR, EPA had a whole house filtration system installed in the home with PCE-contaminated water.

Ongoing Activities

1. DHSS/ATSDR will continue to review information pertaining to the Riverfront site as it

becomes available. Appropriate public health recommendations will be made at that time, if necessary.

2. DHSS will continue to sample private well water in the New Haven area, in conjunction with MDNR, USGS and EPA. Ongoing private well testing and source identification are important tools that will help to better define and understand the health risks associated with this site.

3. DHSS/ATSDR will continue to meet with community members to address any health concerns they may have regarding the site. This will include attending public meetings and availability sessions, meetings with individuals, and responding to requests for information.

Future Activities

1. DHSS/ATSDR will develop and implement a health education plan for the Riverfront site.

2. DHSS/ATSDR will meet with any families identified in future well sampling to have PCE-contamination in their private wells, to answer health questions that they may have.

PREPARERS OF THE REPORT

Sara Colboth and Gale Carlson, Missouri Department of Health and Senior Services

REFERENCES

1. US Environmental Protection Agency. NPL Site Narrative for Riverfront. Internet File located at: http://www.epa.gov/superfund/sites/npl/nar1607.htm

2. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Tetrachloroethylene (update). US Department of Health and Human Services:Atlanta. Sep 97.

3. American Cancer Society. Cancer Information database on the Internet. Internet File located at http://www.cancer.org

CERTIFICATION

This Riverfront Health Consultation was prepared by the Missouri Department of Health and Senior Services under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

Roberta Erlwein
Technical Project Officer, SPS, SSAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

Lisa C. Hayes

APPENDIX

Inhalation Exposure for PCE in Drinking Water

In order to estimate the inhalation exposure residents of New Haven experienced, we need to make some assumptions. These are: a person breathes in approximately 15 cubic meters of air per day; that they live in a 1500 square foot home; that there is 100% PCE volatilization from water; and that water usage in a home is approximately 120 gallons/bedroom.

$$\text{Inhalation Exposure} = \frac{\text{concentration of PCE in water x volume of water used}}{\text{volume of air in home}}$$

Maximum Concentration of PCE in water = 200 ppb or 0.200 ppm or 0.200 mg/L or 0.200 mg/Kg

Volume of water = 3 bedrooms x 120 gallons/bedroom = 360 gallons
360 gallons x 3.785 L/gallon = 1363 Liters x 1 Kg/L = 1363 Kg

Volume of air in home = 1,500 square feet x 8 feet height = 12,000 cubic feet
12,000 cubic feet/ 35.314 cubic foot/cubic meter = 340 cubic meters air

$$\text{Inhalation Exposure} = \frac{\text{0.200 mg PCE/Kg water x 1363 Kg water}}{\text{340 cubic meters air}}$$

Inhalation Exposure = 0.810 mg PCE/cubic meter air
The MRL for acute exposure to PCE in air is 0.200 parts per million.
1 part per million is equal to 5.4 mg/cubic meter
Therefore, the acute MRL is equal to 1.08 mg/cubic meter

The MRL for chronic exposure to PCE in air is 0.040 parts per million
1 part per million is equal to 5.4 mg/cubic meter
Therefore, the chronic MRL is equal to 0.216 mg/cubic meter

The inhalation exposure at Riverfront site for acute exposures is slightly lower than the MRL, however the inhalation exposure for chronic exposures is slightly higher than the MRL.

Because we make certain assumptions, about the types of houses that people live in to calculate a dose, DOH re-calculated the inhalation exposure dose using different housing scenarios. These are: a person breathes in approximately 15 cubic meters of air per day; that they live in a 1000 square foot, two bedroom home; that there is 100% PCE volatilization from water; and that water usage in a home is approximately 120 gallons/ bedroom. With this scenario,

$$\text{Inhalation Exposure} = \frac{\text{0.200 mg PCE/Kg water x 908 Kg water}}{\text{227 cubic meters air}}$$

Inhalation Exposure = 0.80 mg PCE/cubic meter air

In the next scenario, we will make the following assumptions: a person breathes in approximately 15 cubic meters of air per day, that they live in a 1200 square foot 3 bedroom home; that there is 100% PCE volatilization from water; and that water usage in a home is approximately 120 gallons/bedroom. With this

scenario,

$$\text{Inhalation Exposure} = \frac{0.200 \text{ mg PCE/Kg water x } 1363 \text{ Kg water}}{272 \text{ cubic meters air}}$$

Inhalation Exposure = 1.01 mg PCE/cubic meter air

In the last scenario, we will make the following assumptions: a person breathes in approximately 15 cubic meters of air per day, that they live in a 2000 square foot, 4 bedroom home; that there is 100% PCE volatilization from water; and that water usage in a home is approximately 120 gallons/bedroom. With this scenario,

$$\text{Inhalation Exposure} = \frac{0.200 \text{ mg PCE/Kg water x } 1816 \text{ Kg water}}{453 \text{ cubic meters air}}$$

Inhalation Exposure = 0.81 mg PCE/cubic meter air

Ingestion Exposure for PCE in drinking water

$$\text{Ingestion Exposure Dose} = \frac{C \times IR \times EF}{BW}$$

where:
C = contaminant concentration (mg/L)
IR = ingestion rate
EF = Exposure Factor
BW = body weight

Adult:

$$\text{Ingestion Exposure Dose} = \frac{0.200 \text{ PCE mg/L x } 2 \text{ L/day water x } 1}{70 \text{ kg}}$$

Ingestion Exposure Dose = 0.01 mg/Kg/day

This calculation assumes that an adult weighs 70 Kg and drinks 2 L of tap water per day.

Child:

$$\text{Ingestion Exposure Dose} = \frac{0.200 \text{ PCE mg/L x } 1 \text{ L/day water x } 1}{10 \text{ Kg}}$$

Ingestion Exposure Dose = 0.02 mg/Kg/day

This calculation assumes that a child weighs 10 Kg and drinks 1 L of tap water per day.

Cancer Calculations

Formula:

$$\frac{\text{Exposure dose x risk factor x years exposure}}{\text{70 years (lifetime)}} = \text{risk of cancer}$$

Inhalation exposure:

$$\frac{\text{0.81 mg/cubic meter x 0.0143 x 20 years}}{\text{70 years}} = \text{risk of cancer}$$

0.00330 = risks of cancer
or 3.3×10^{-3} = risks of cancer

Ingestion exposure:

$$\frac{\text{0.01 mg/Kg/day x 0.0143 x 20 years}}{\text{70 years}} = \text{cancer risk}$$

0.000040 = risks of cancer
Or 4.0×10^{-5} = risks of cancer

FIGURES

Figure 1. The location of New Haven, Missouri, and the four operable units (OUs) of the Riverfront Site

Figure 2. Current Site Map

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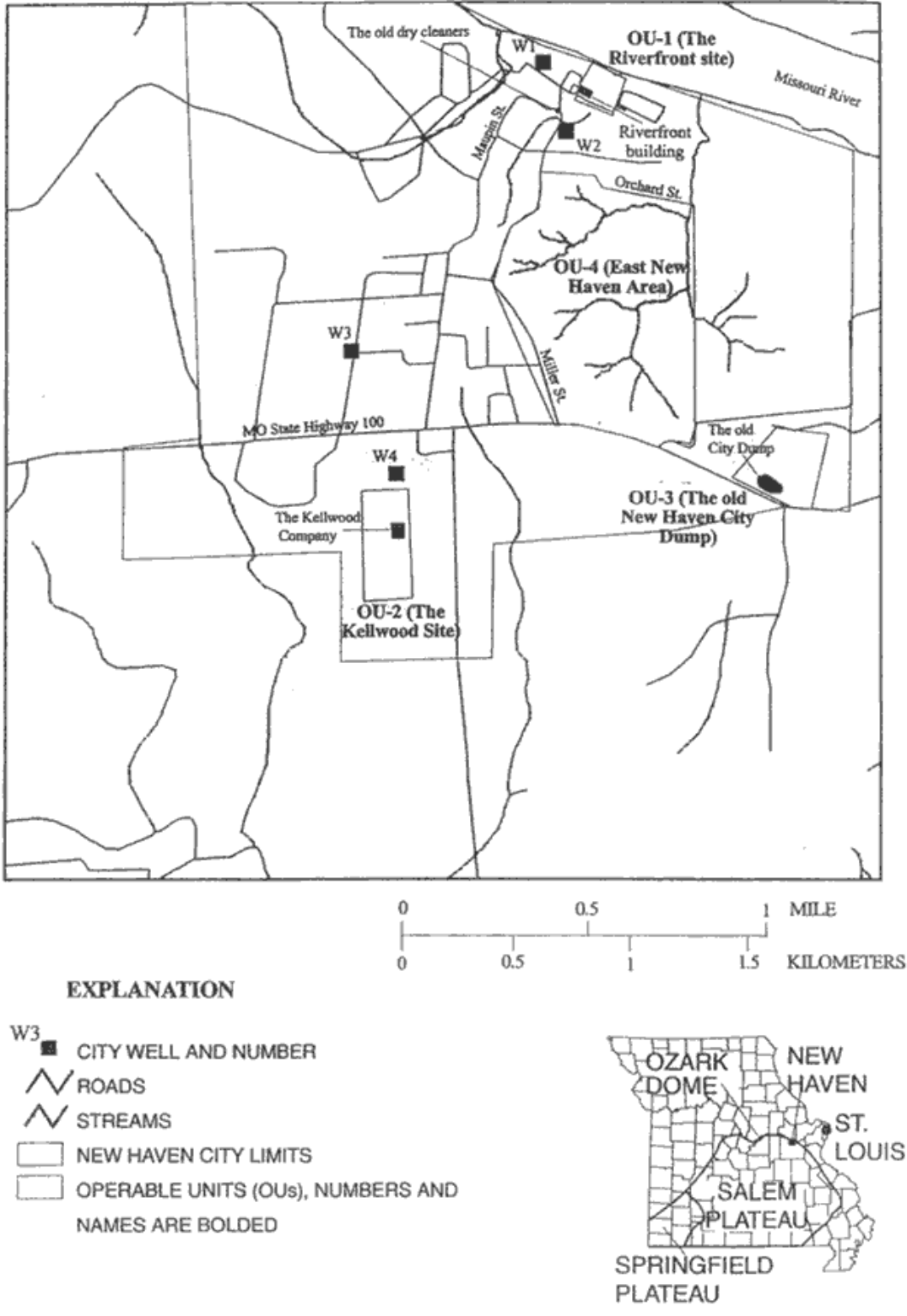
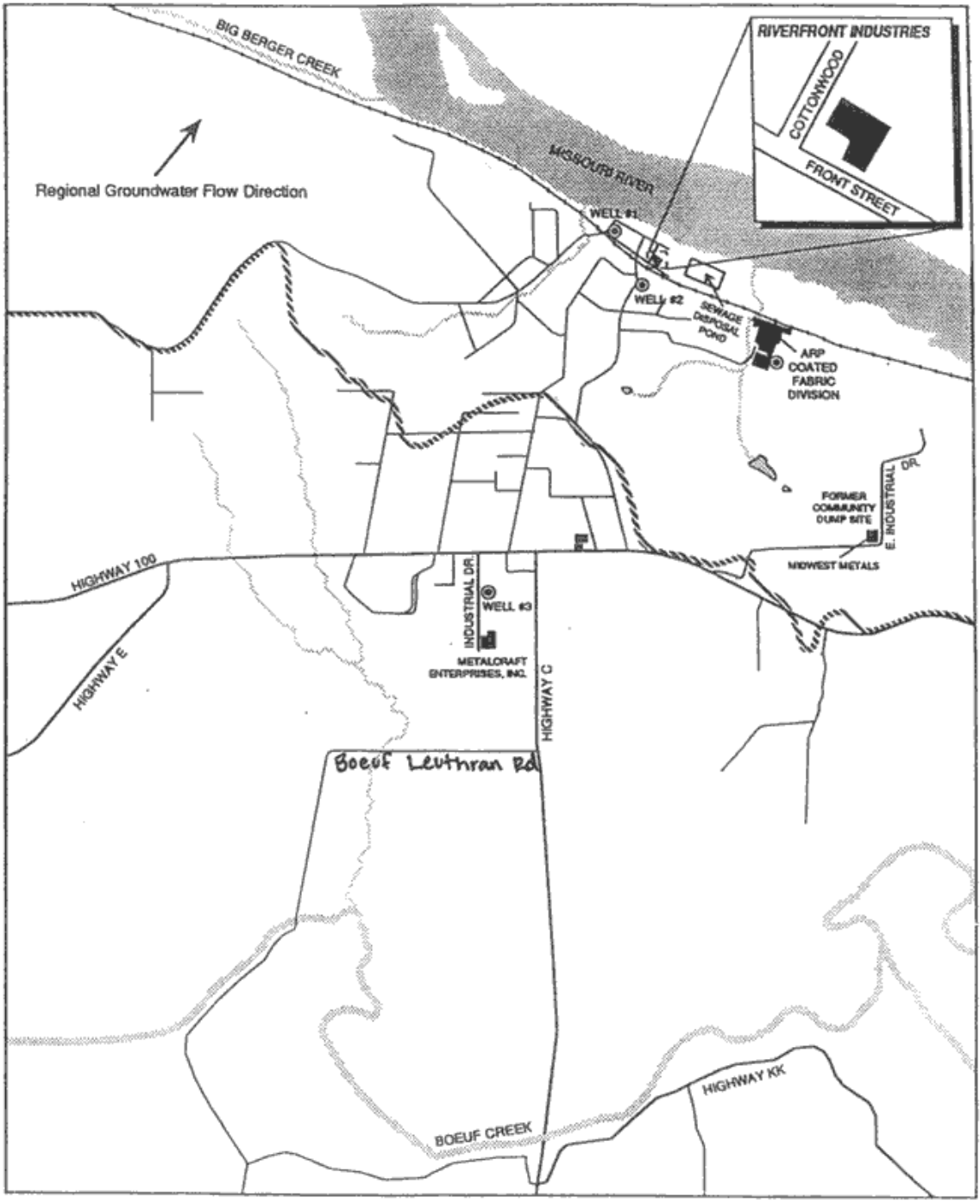


FIGURE 1. The location of New Haven, Missouri, and the four operable units (OUs) of the Riverfront Site.



LEGEND

- Well Locations
- Surface Water Divide, the Groundwater Divide occurs just South of this

0 .5 1

Approximate Scale in Miles

FIGURE DESCRIPTION

Current Site Map

SITE NAME/LOCATION

New Haven Public Water Supply
New Haven, Missouri

JACOBS PROJECT NO

12-D253-32

JACOBS ENGINEERING GROUP INC.

ARCS

DRAWN BY MD DATE 12/27/93

CHECKED BY LS DATE 12/27/93

FIGURE NO

2